GLOBAL PRECIPITATION MEASUREMENT PRECIPITATION PROCESSING SYSTEM

File Specification
1CSSMIS

Preliminary Version

February 14, 2014

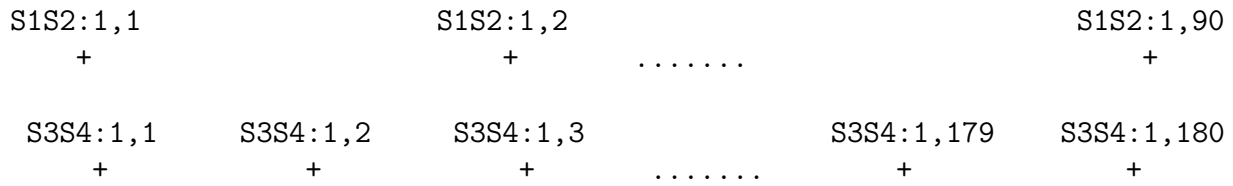
0.1 1CSSMIS - Common Calibrated Brightness Temperature

1CSSMIS contains common calibrated brightness temperature from the SSMIS passive microwave instruments flown on the DMSP satellites. Swath S1 has 3 low frequency channels (19V 19H 22V). Swath S2 has 2 low frequency channels (37V 37H). Swath S3 has 4 high frequency channels (150H 183+/-1H 183+/-3H 183+/-7H). S4 has 2 high frequency channels (91V 91H). All the above frequencies are in GHz.

Earth observations for all four swaths are taken during a 144^o segment of the instrument rotation when SSMIS scans in the direction of foreward satellite motion. We define the spacecraft vector (v) at the center of this segment. "v" is used in the definition of the variable SCorientation.

RELATION BETWEEN THE SWATHS: Each S1 and S2 scan contains low frequency channels sampled 90 times along the scan. Each S3 and S4 scan contains high frequency channels sampled 180 times along the scan. All four swaths have exactly the same number of scans. All four swaths repeat scans every 1.9s. The earth positions of S1 are very close to those of S2. The earth positions of S3 are very close to those of S4. The earth positions of S1 and S2 alternate with those of S3 and S4 along the satellite track. The positions of the S1 and S2 pixels do not match the positions of the S3 and S4 pixels.

The Figure below shows the locations of the samples of Swath S1 and Swath S2 scan 1 and Swath S3 and Swath S4 scan 1. Each "+" represents centers of samples from two swaths. For example, the label "S1S2:1,2" means that Swath S1 and Swath S2, scan 1, sample 2 is located approximately at the "+". The positions of S1 and S2 are slightly different from each other but close enough to be represented by the same "+" in the Figure. The positions of S3 and S4 are slightly different from each other but close enough to be represented by the same "+" in the Figure.



KNOWN PROBLEMS OR ISSUES WITH REVISION 2 DATA: None

Dimension definitions:

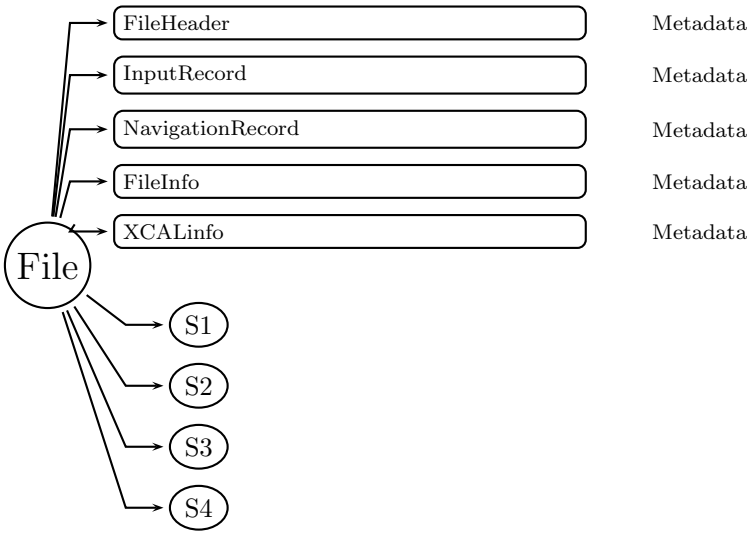


Figure 1: Data Format Structure for 1CSSMIS, Common Calibrated Brightness Temperature

nscan1	var	Number of Swath S1 scans in the granule.
nchannel1	3	Number of Swath S1 channels.
npixel1	90	Number of Swath S1 pixels in one scan.
nchUIA1	1	Number of Swath S1 unique incidence angles.
nscan2	var	Number of Swath S2 scans in the granule.
nchannel2	2	Number of Swath S2 channels.
npixel2	90	Number of Swath S2 pixels in one scan.
nchUIA2	1	Number of Swath S2 unique incidence angles.
nscan3	var	Number of Swath S3 scans in the granule.
nchannel3	4	Number of Swath S3 channels.
npixel3	180	Number of Swath S3 pixels in one scan.
nchUIA3	1	Number of Swath S3 unique incidence angles.
nscan4	var	Number of Swath S4 scans in the granule.
nchannel4	2	Number of Swath S4 channels.
npixel4	180	Number of Swath S4 pixels in one scan.
nchUIA4	1	Number of Swath S4 unique incidence angles.

Figure 1 through Figure 13 show the structure of this product. The text below describes the contents of objects in the structure, the C Structure Header File and the Fortran Structure Header File.

FileHeader (Metadata):
FileHeader contains general metadata. This group appears in all data products. See Metadata for GPM Products for details.

InputRecord (Metadata):
InputRecord contains a record of input files for this granule. This group appears in Level 1 and Level 2 data products. Level 3 time averaged products have the same information separated into 3 groups since they have many inputs. See Metadata for GPM Products

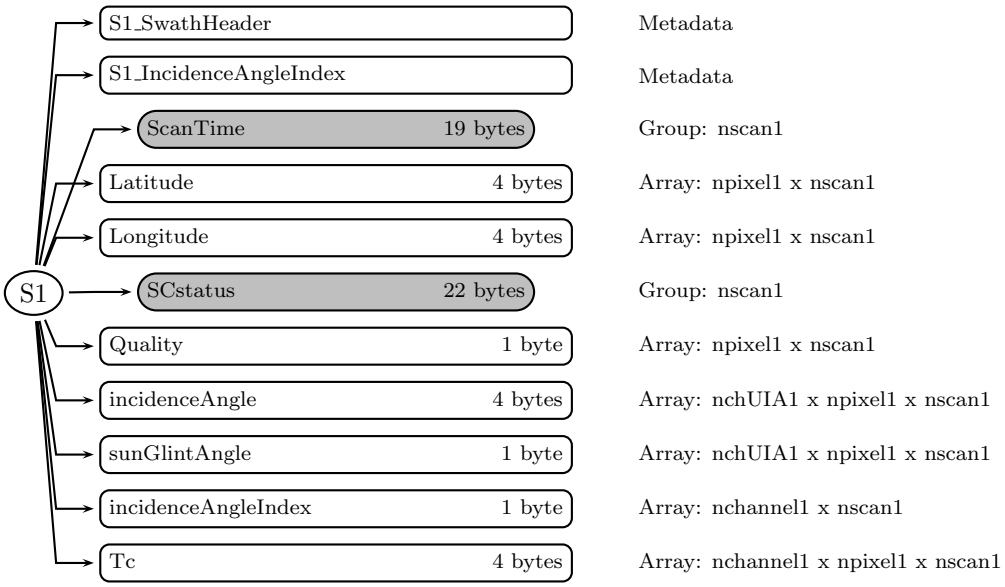


Figure 2: Data Format Structure for 1CSSMIS, S1

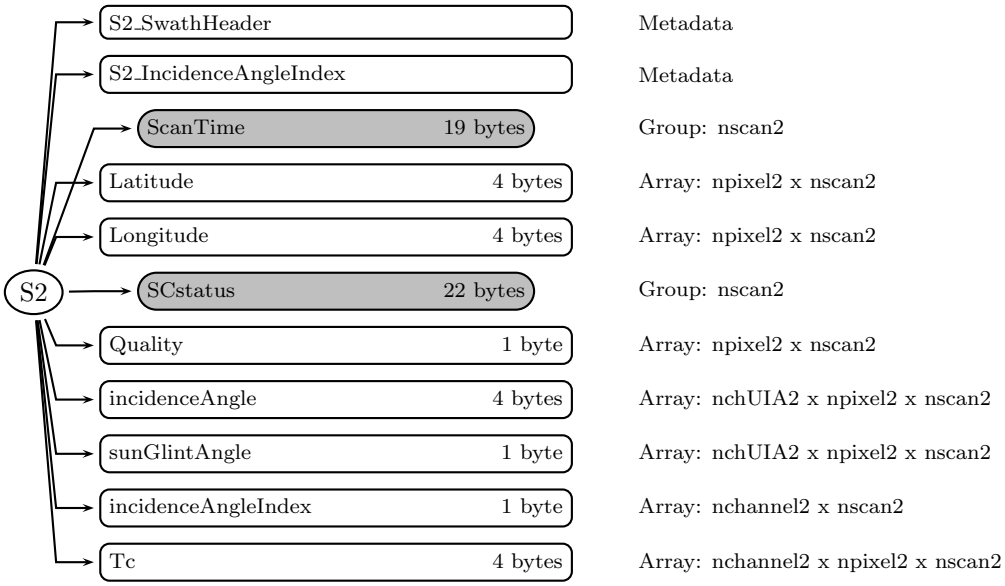


Figure 3: Data Format Structure for 1CSSMIS, S2

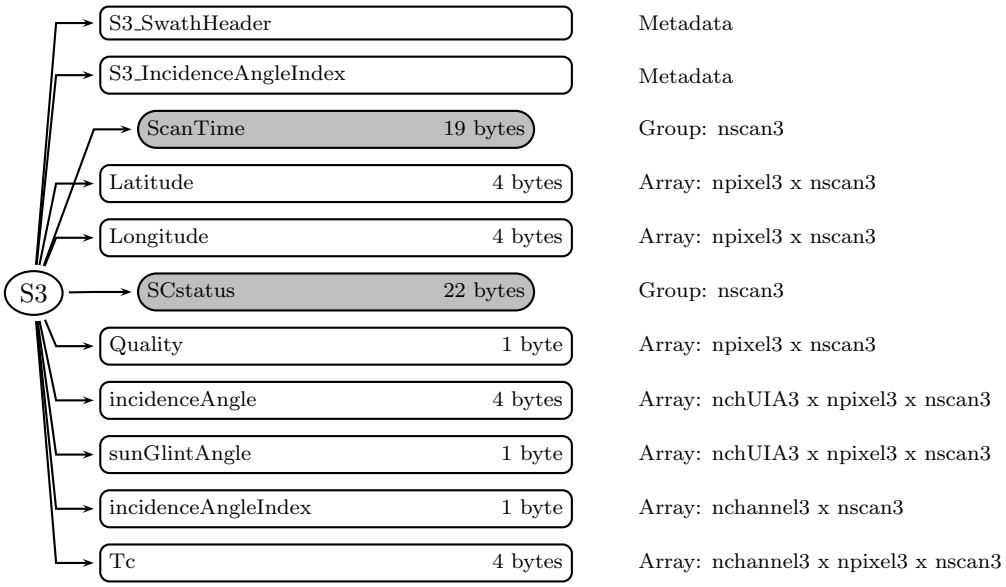


Figure 4: Data Format Structure for 1CSSMIS, S3

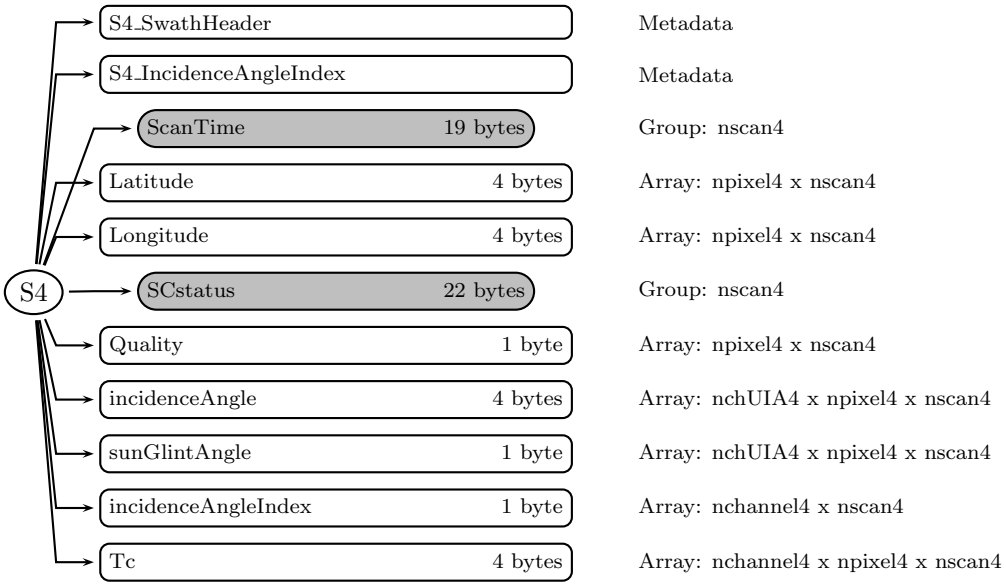


Figure 5: Data Format Structure for 1CSSMIS, S4

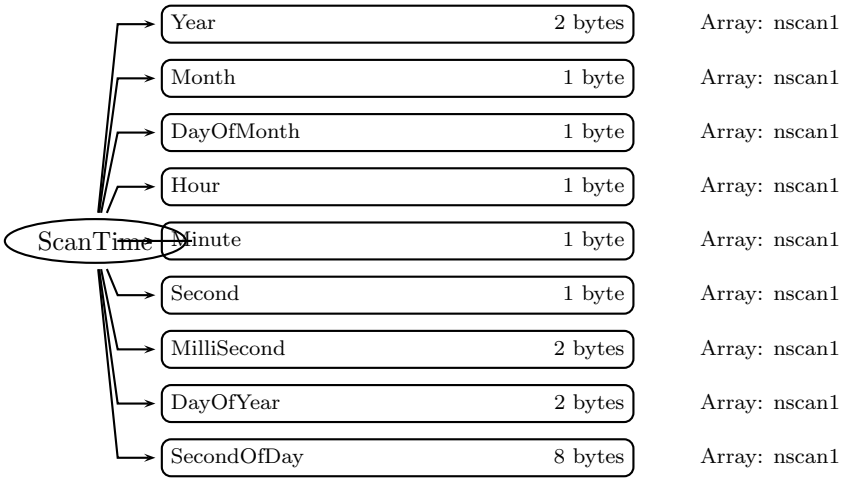


Figure 6: Data Format Structure for 1CSSMIS, S1, ScanTime

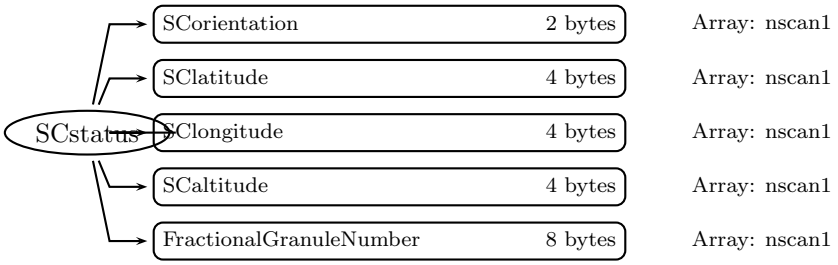


Figure 7: Data Format Structure for 1CSSMIS, S1, SCstatus

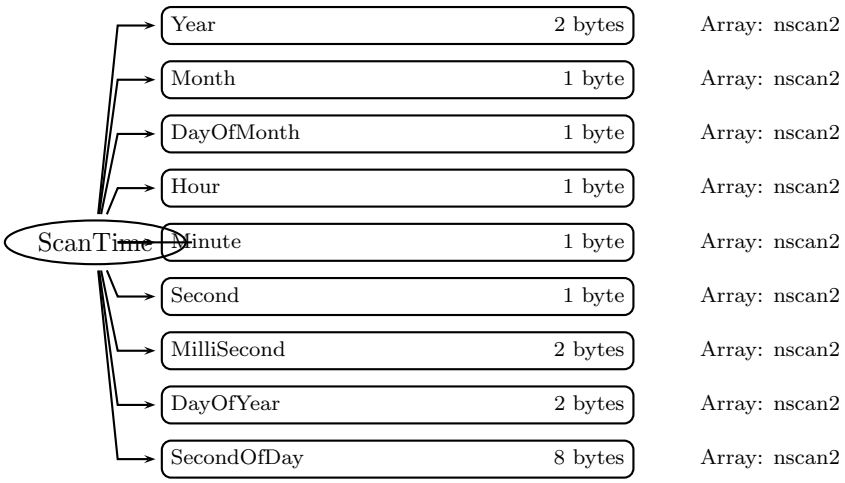


Figure 8: Data Format Structure for 1CSSMIS, S2, ScanTime

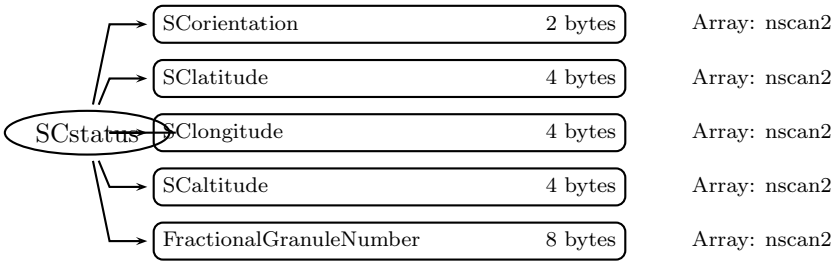


Figure 9: Data Format Structure for 1CSSMIS, S2, SCstatus

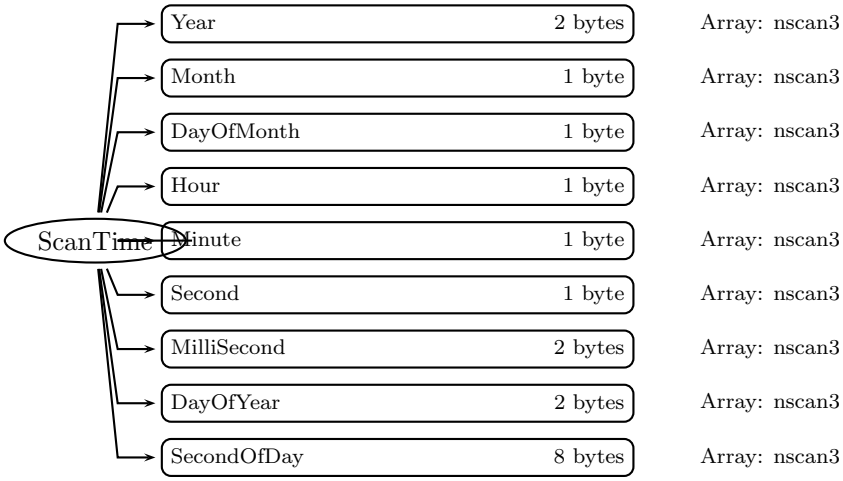


Figure 10: Data Format Structure for 1CSSMIS, S3, ScanTime

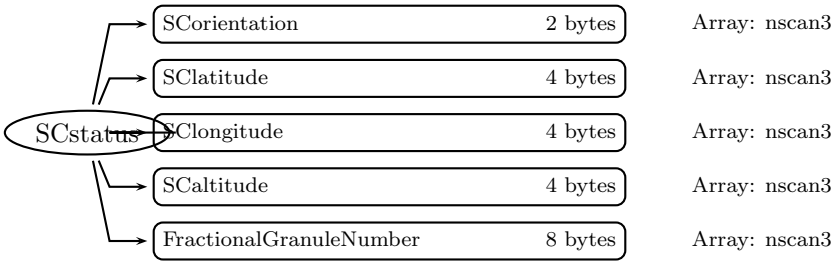


Figure 11: Data Format Structure for 1CSSMIS, S3, SCstatus

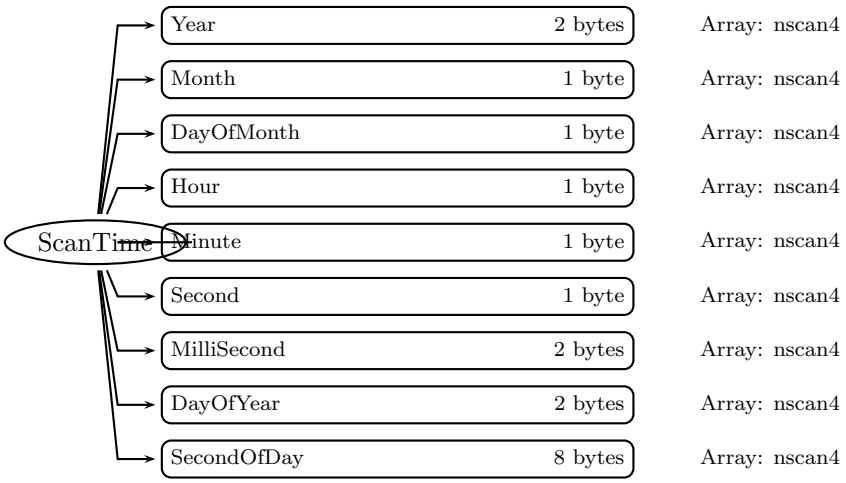


Figure 12: Data Format Structure for 1CSSMIS, S4, ScanTime

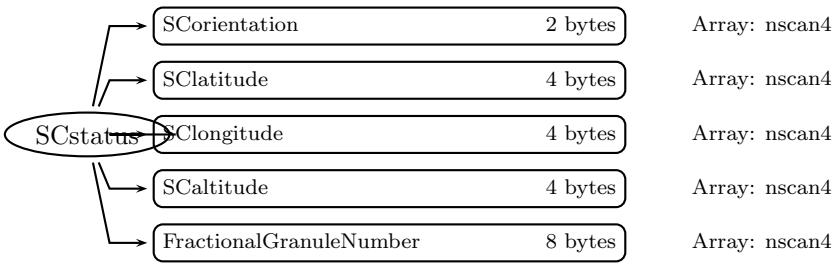


Figure 13: Data Format Structure for 1CSSMIS, S4, SCstatus

for details.

NavigationRecord (Metadata):
NavigationRecord contains navigation metadata for this granule. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

FileInfo (Metadata):
FileInfo contains metadata used by the PPS I/O Toolkit (TKIO). This group appears in all data products. See Metadata for GPM Products for details.

XCALinfo (Metadata):
XCALinfo contains metadata required by 1C intercalibrated files. See Metadata for GPM Products for details.

S1 (Swath)

S1_SwathHeader (Metadata):
SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S1_IncidenceAngleIndex (Metadata):
IncidenceAngleIndex contains a list of indeces of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S1)

Year (2-byte integer, array size: nscan1):
4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:
-9999 Missing value

Month (1-byte integer, array size: nscan1):
Month of the year. Values range from 1 to 12 months. Special values are defined as:
-99 Missing value

DayOfMonth (1-byte integer, array size: nscan1):
Day of the month. Values range from 1 to 31 days. Special values are defined as:
-99 Missing value

Hour (1-byte integer, array size: nscan1):
UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:
-99 Missing value

Minute (1-byte integer, array size: nscan1):
Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:
-99 Missing value

Second (1-byte integer, array size: nscan1):
Second of the minute. Values range from 0 to 60 s. Special values are defined as:
-99 Missing value

MilliSecond (2-byte integer, array size: nscan1):
Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:
-9999 Missing value

DayOfYear (2-byte integer, array size: nscan1):
Day of the year. Values range from 1 to 366 days. Special values are defined as:
-9999 Missing value

SecondOfDay (8-byte float, array size: nscan1):
A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:
-9999.9 Missing value

Latitude (4-byte float, array size: npixel1 x nscan1):
The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

Longitude (4-byte float, array size: npixel1 x nscan1):
The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCstatus (Group in S1)

SCorientation (2-byte integer, array size: nscan1):
The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:
-9999 Missing value

SClatitude (4-byte float, array size: nscan1):
Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

SClongitude (4-byte float, array size: nscan1):
Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan1):
Values range from 0 to 1000 km. Special values are defined as:
-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan1):
The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the

spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:
-9999.9 Missing value

Quality (1-byte integer, array size: npixel1 x nscan1):
Quality of Tc in the swath.

```
GENERAL SPECIFICATIONS:
   0 = Good data in all channels in the swath
gt 0 = Cautionary warning flags
             1-99 = Generic flags (all sensors)
          100-127 = Sensor specific flags
lt 0 = Major errors resulting in missing data
          -(1-98) = Generic flags (all sensors)
              -99 = Missing value (no quality information available)
       -(100-127) = Sensor specific flags

DETAILED SPECIFICATIONS:
   0 = Good data
   1 = Possible sun glint
   2 = Possible radio frequency interference
   3 = Degraded geolocation data
   4 = Data corrected for warm load intrusion

 102 = Climatology check warning 19V channel
 103 = Climatology check warning 19H channel
 104 = Climatology check warning 22V channel
 105 = Climatology check warning 37V channel
 106 = Climatology check warning 37H channel
 107 = Climatology check warning 91V channel
 108 = Climatology check warning 91H channel
 109 = Climatology check warning 150H channel
 110 = Climatology check warning 183+/-1 channel
 111 = Climatology check warning 183+/-3 channel
 112 = Climatology check warning 183+/-7 channel
 113 = Climatology check warning Multiple enviro sensor channels
 114 = Climatology check warning Multiple imager sensor channels
 115 = Climatology check warning One or more LAS sensor channels
 116 = Climatology check warning One or more UAS sensor channels
 117 = Climatology check warning Correction for lunar intrusion into warm load
 118 = Climatology check warning Correction for solar intrusion into warm load

  -1 = Data is missing from file or unreadable
```

```
  -2 = Unphysical brightness temperature (Tb lt 50K or 350K gt Tb)
  -3 = Error in geolocation data
  -4 = Data missing in one channel
  -5 = Data missing in multiple channels
  -6 = Lat/lon values are out of range
 -99 = Missing value (no quality information available)

-102 = Climatology check flagged in input BASE file
-110 = Climatology check failure 19V channel
-111 = Climatology check failure 19H channel
-112 = Climatology check failure 22V channel
-113 = Climatology check failure 37V channel
-114 = Climatology check failure 37H channel
-115 = Climatology check failure 91V channel
-116 = Climatology check failure 91H channel
-117 = Climatology check failure 150H channel
-118 = Climatology check failure 183+/-1 channel
-119 = Climatology check failure 183+/-3 channel
-120 = Climatology check failure 183+/-7 channel
-121 = Climatology check failure Multiple enviro sensor channels
-122 = Climatology check failure Multiple imager sensor channels
-123 = Climatology check failure One or more LAS sensor channels
-124 = Climatology check failure One or more UAS sensor channels
-125 = Failure of 150H channel on DMSP F18
```

incidenceAngle (4-byte float, array size: nchUIA1 x npixel1 x nscan1):
Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA1 x npixel1 x nscan1):
Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel1 x nscan1):

```
Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

  incidenceAngle(2,npixel,nscan)
  sunGlintAngle(2,npixel,nscan)
```

```
  incidenceAngleIndex(10,nscan)
  Tc(10,npixel,nscan)

The user would do the following to retreive the angles
for a given channel, pixel, and scan:

  i = incidenceAngleIndex(channel,scan)
  ia = incidenceAngle(i,pixel,scan)
  sga = sunGlintAngle(i,pixel,scan)

The incidenceAngleIndex is the same for every scan,
but is repeated each scan for the convenience of users
reading the data scan by scan.  In addition,
incidenceAngleIndex is located in metadata for the
convenience of users wishing to read this information
from metadata.
```

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: nchannel1 x npixel1 x nscan1):
GPM Common Calibrated Brightness Temperature. The channels are:

```
19.35  GHz vertically-polarized   TBs
19.35  GHz horizontally-polarized TBs
22.235 GHz vertically-polarized   TBs
```

S2 (Swath)

S2_SwathHeader (Metadata):
SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S2_IncidenceAngleIndex (Metadata):
IncidenceAngleIndex contains a list of indeces of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S2)

Year (2-byte integer, array size: nscan2):
4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:
-9999 Missing value

Month (1-byte integer, array size: nscan2):
Month of the year. Values range from 1 to 12 months. Special values are defined as:
-99 Missing value

DayOfMonth (1-byte integer, array size: nscan2):
Day of the month. Values range from 1 to 31 days. Special values are defined as:
-99 Missing value

Hour (1-byte integer, array size: nscan2):
UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:
-99 Missing value

Minute (1-byte integer, array size: nscan2):
Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:
-99 Missing value

Second (1-byte integer, array size: nscan2):
Second of the minute. Values range from 0 to 60 s. Special values are defined as:
-99 Missing value

MilliSecond (2-byte integer, array size: nscan2):
Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:
-9999 Missing value

DayOfYear (2-byte integer, array size: nscan2):
Day of the year. Values range from 1 to 366 days. Special values are defined as:
-9999 Missing value

SecondOfDay (8-byte float, array size: nscan2):
A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:
-9999.9 Missing value

Latitude (4-byte float, array size: npixel2 x nscan2):
The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

Longitude (4-byte float, array size: npixel2 x nscan2):
The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCstatus (Group in S2)

SCorientation (2-byte integer, array size: nscan2):
The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined

in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:
-9999 Missing value

SClatitude (4-byte float, array size: nscan2):
Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

SClongitude (4-byte float, array size: nscan2):
Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan2):
Values range from 0 to 1000 km. Special values are defined as:
-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan2):
The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:
-9999.9 Missing value

Quality (1-byte integer, array size: npixel2 x nscan2):
Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

```
 0 = Good data in all channels in the swath
 1 = Possible sun glint
 2 = Climatology QC check warning
10 = Data is missing from input file or unreadable
20 = Geolocation check flagged pixel as bad
30 = Climatology check flagged pixel as bad
40 = Distance between pixels is nonphysical
50 = Antenna temperatures are less than 50 K or greater than 325 K
60 = Lat/lon values are out of range
70 = Adjacent/cross-pol pixel flagged as bad
```

incidenceAngle (4-byte float, array size: nchUIA2 x npixel2 x nscan2):
Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA2 x npixel2 x nscan2):
Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel2 x nscan2):

```
Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

  incidenceAngle(2,npixel,nscan)
  sunGlintAngle(2,npixel,nscan)
  incidenceAngleIndex(10,nscan)
  Tc(10,npixel,nscan)

The user would do the following to retreive the angles
for a given channel, pixel, and scan:

  i = incidenceAngleIndex(channel,scan)
  ia = incidenceAngle(i,pixel,scan)
  sga = sunGlintAngle(i,pixel,scan)

The incidenceAngleIndex is the same for every scan,
but is repeated each scan for the convenience of users
reading the data scan by scan.  In addition,
incidenceAngleIndex is located in metadata for the
convenience of users wishing to read this information
from metadata.
```

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: nchannel2 x npixel2 x nscan2):
GPM Common Calibrated Brightness Temperature. The channels are:

```
37.0   GHz vertically-polarized   TBs
37.0   GHz horizontally-polarized TBs
```

S3 (Swath)

S3_SwathHeader (Metadata):
SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S3_IncidenceAngleIndex (Metadata):
IncidenceAngleIndex contains a list of indeces of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S3)

Year (2-byte integer, array size: nscan3):
4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:
-9999 Missing value

Month (1-byte integer, array size: nscan3):
Month of the year. Values range from 1 to 12 months. Special values are defined as:
-99 Missing value

DayOfMonth (1-byte integer, array size: nscan3):
Day of the month. Values range from 1 to 31 days. Special values are defined as:
-99 Missing value

Hour (1-byte integer, array size: nscan3):
UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:
-99 Missing value

Minute (1-byte integer, array size: nscan3):
Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:
-99 Missing value

Second (1-byte integer, array size: nscan3):
Second of the minute. Values range from 0 to 60 s. Special values are defined as:
-99 Missing value

MilliSecond (2-byte integer, array size: nscan3):
Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:
-9999 Missing value

DayOfYear (2-byte integer, array size: nscan3):
Day of the year. Values range from 1 to 366 days. Special values are defined as:
-9999 Missing value

SecondOfDay (8-byte float, array size: nscan3):
A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:
-9999.9 Missing value

Latitude (4-byte float, array size: npixel3 x nscan3):
The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

Longitude (4-byte float, array size: npixel3 x nscan3):
The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCstatus (Group in S3)

SCorientation (2-byte integer, array size: nscan3):
The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:
-9999 Missing value

SClatitude (4-byte float, array size: nscan3):
Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

SClongitude (4-byte float, array size: nscan3):
Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan3):
Values range from 0 to 1000 km. Special values are defined as:
-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan3):
The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:
-9999.9 Missing value

Quality (1-byte integer, array size: npixel3 x nscan3):
Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

```
 0 = Good data in all channels in the swath
 1 = Possible sun glint
 2 = Climatology QC check warning
10 = Data is missing from input file or unreadable
20 = Geolocation check flagged pixel as bad
30 = Climatology check flagged pixel as bad
40 = Distance between pixels is nonphysical
```

```
50 = Antenna temperatures are less than 50 K or greater than 325 K
60 = Lat/lon values are out of range
70 = Adjacent/cross-pol pixel flagged as bad
```

incidenceAngle (4-byte float, array size: nchUIA3 x npixel3 x nscan3):
Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA3 x npixel3 x nscan3):
Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel3 x nscan3):

```
Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

  incidenceAngle(2,npixel,nscan)
  sunGlintAngle(2,npixel,nscan)
  incidenceAngleIndex(10,nscan)
  Tc(10,npixel,nscan)

The user would do the following to retreive the angles
for a given channel, pixel, and scan:

  i = incidenceAngleIndex(channel,scan)
  ia = incidenceAngle(i,pixel,scan)
  sga = sunGlintAngle(i,pixel,scan)

The incidenceAngleIndex is the same for every scan,
but is repeated each scan for the convenience of users
reading the data scan by scan.  In addition,
incidenceAngleIndex is located in metadata for the
convenience of users wishing to read this information
from metadata.
```

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: nchannel3 x npixel3 x nscan3):
GPM Common Calibrated Brightness Temperature. The channels are:

```
150 GHz horizontally-polarized TBs
183.31 +/- 1 GHz horizontally-polarized TBs
183.31 +/- 3 GHz horizontally-polarized TBs
183.31 +/- 7 GHz horizontally-polarized TBs
```

S4 (Swath)

S4_SwathHeader (Metadata):
SwathHeader contains metadata for swaths. This group appears in Level 1 and Level 2 data products. See Metadata for GPM Products for details.

S4_IncidenceAngleIndex (Metadata):
IncidenceAngleIndex contains a list of indeces of the incidence angle array and sun glint angle array. See the description of the data array incidenceAngleIndex for details.

ScanTime (Group in S4)

Year (2-byte integer, array size: nscan4):
4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:
-9999 Missing value

Month (1-byte integer, array size: nscan4):
Month of the year. Values range from 1 to 12 months. Special values are defined as:
-99 Missing value

DayOfMonth (1-byte integer, array size: nscan4):
Day of the month. Values range from 1 to 31 days. Special values are defined as:
-99 Missing value

Hour (1-byte integer, array size: nscan4):
UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:
-99 Missing value

Minute (1-byte integer, array size: nscan4):
Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:
-99 Missing value

Second (1-byte integer, array size: nscan4):
Second of the minute. Values range from 0 to 60 s. Special values are defined as:
-99 Missing value

MilliSecond (2-byte integer, array size: nscan4):
Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:
-9999 Missing value

DayOfYear (2-byte integer, array size: nscan4):
Day of the year. Values range from 1 to 366 days. Special values are defined as:
-9999 Missing value

SecondOfDay (8-byte float, array size: nscan4):
A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:
-9999.9 Missing value

Latitude (4-byte float, array size: npixel4 x nscan4):
The earth latitude of the center of the IFOV at the altitude of the earth ellipsiod. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

Longitude (4-byte float, array size: npixel4 x nscan4):
The earth longitude of the center of the IFOV at the altitude of the earth ellipsiod. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCstatus (Group in S4)

SCorientation (2-byte integer, array size: nscan4):
The angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. The relationship of v to the sensor geometry is defined in the introduction to this algorithm. Values range from 0 to 360 degrees. Special values are defined as:
-9999 Missing value

SClatitude (4-byte float, array size: nscan4):
Values range from -90 to 90 degrees. Special values are defined as:
-9999.9 Missing value

SClongitude (4-byte float, array size: nscan4):
Values range from -180 to 180 degrees. Special values are defined as:
-9999.9 Missing value

SCaltitude (4-byte float, array size: nscan4):
Values range from 0 to 1000 km. Special values are defined as:
-9999.9 Missing value

FractionalGranuleNumber (8-byte float, array size: nscan4):
The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:
-9999.9 Missing value

Quality (1-byte integer, array size: npixel4 x nscan4):
Quality of Tc in the swath. A zero value indicates good Tc. Values from 1 to 9 indicate cautionary flags. Tc was not set to the missing value. Values from 10 to 90 indicate major issues resulting in missing values for at least one channel. Flags are set in the following order of priority: 10, 20, 30, 40, 50, 60, 70, 1, 2, 0. Specific flag values are:

```
 0 = Good data in all channels in the swath
 1 = Possible sun glint
 2 = Climatology QC check warning
10 = Data is missing from input file or unreadable
20 = Geolocation check flagged pixel as bad
30 = Climatology check flagged pixel as bad
40 = Distance between pixels is nonphysical
50 = Antenna temperatures are less than 50 K or greater than 325 K
60 = Lat/lon values are out of range
70 = Adjacent/cross-pol pixel flagged as bad
```

incidenceAngle (4-byte float, array size: nchUIA4 x npixel4 x nscan4):
Earth incidence angle. Values range from 0 to 90 degrees. Special values are defined as:
-9999.9 Missing value

sunGlintAngle (1-byte integer, array size: nchUIA4 x npixel4 x nscan4):
Sun glint angle. Angles greater than 127 degrees are set to 127. Values range from 0 to 127 degrees. Sun below horizon value is -88. Missing value is -99.

incidenceAngleIndex (1-byte integer, array size: nchannel4 x nscan4):

```
Index (1 based as in Fortran) of
the incidence angle array corresponding to the channel.
For example, if the swath has 10 channels and
2 unique incidence angles, then the dimensions
in Fortran would be:

  incidenceAngle(2,npixel,nscan)
  sunGlintAngle(2,npixel,nscan)
  incidenceAngleIndex(10,nscan)
  Tc(10,npixel,nscan)

The user would do the following to retreive the angles
for a given channel, pixel, and scan:

  i = incidenceAngleIndex(channel,scan)
  ia = incidenceAngle(i,pixel,scan)
```

```
        sga = sunGlintAngle(i,pixel,scan)

      The incidenceAngleIndex is the same for every scan,
      but is repeated each scan for the convenience of users
      reading the data scan by scan.  In addition,
      incidenceAngleIndex is located in metadata for the
      convenience of users wishing to read this information
      from metadata.
```

Values range from 0 to 100. Special values are defined as:
-99 Missing value

Tc (4-byte float, array size: nchannel4 x npixel4 x nscan4):
GPM Common Calibrated Brightness Temperature. The channels are:

```
        91.665 GHz vertically-polarized   TBs
        91.665 GHz horizontally-polarized TBs
```

C Structure Header file:

```
#ifndef _TK_1CSSMIS_H_
#define _TK_1CSSMIS_H_

#ifndef _L1CSSMIS_S4_
#define _L1CSSMIS_S4_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[180];
    float Longitude[180];
    SCSTATUS SCstatus;
    signed char Quality[180];
    float incidenceAngle[180][1];
    signed char sunGlintAngle[180][1];
    signed char incidenceAngleIndex[2];
    float Tc[180][2];
} L1CSSMIS_S4;

#endif

#ifndef _L1CSSMIS_S3_
#define _L1CSSMIS_S3_
```

```
typedef struct {
    SCANTIME ScanTime;
    float Latitude[180];
    float Longitude[180];
    SCSTATUS SCstatus;
    signed char Quality[180];
    float incidenceAngle[180][1];
    signed char sunGlintAngle[180][1];
    signed char incidenceAngleIndex[4];
    float Tc[180][4];
} L1CSSMIS_S3;

#endif

#ifndef _L1CSSMIS_S2_
#define _L1CSSMIS_S2_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[90];
    float Longitude[90];
    SCSTATUS SCstatus;
    signed char Quality[90];
    float incidenceAngle[90][1];
    signed char sunGlintAngle[90][1];
    signed char incidenceAngleIndex[2];
    float Tc[90][2];
} L1CSSMIS_S2;

#endif

#ifndef _SCSTATUS_
#define _SCSTATUS_

typedef struct {
    short SCorientation;
    float SClatitude;
    float SClongitude;
    float SCaltitude;
    double FractionalGranuleNumber;
} SCSTATUS;
```

```
#endif

#ifndef _SCANTIME_
#define _SCANTIME_

typedef struct {
    short Year;
    signed char Month;
    signed char DayOfMonth;
    signed char Hour;
    signed char Minute;
    signed char Second;
    short MilliSecond;
    short DayOfYear;
    double SecondOfDay;
} SCANTIME;

#endif

#ifndef _L1CSSMIS_S1_
#define _L1CSSMIS_S1_

typedef struct {
    SCANTIME ScanTime;
    float Latitude[90];
    float Longitude[90];
    SCSTATUS SCstatus;
    signed char Quality[90];
    float incidenceAngle[90][1];
    signed char sunGlintAngle[90][1];
    signed char incidenceAngleIndex[3];
    float Tc[90][3];
} L1CSSMIS_S1;

#endif

#ifndef _L1CSSMIS_SWATHS_
#define _L1CSSMIS_SWATHS_

typedef struct {
    L1CSSMIS_S1 S1;
    L1CSSMIS_S2 S2;
    L1CSSMIS_S3 S3;
```

```
    L1CSSMIS_S4 S4;
} L1CSSMIS_SWATHS;

#endif

#endif
```

Fortran Structure Header file:

```
STRUCTURE /L1CSSMIS_S4/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(180)
    REAL*4 Longitude(180)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(180)
    REAL*4 incidenceAngle(1,180)
    BYTE sunGlintAngle(1,180)
    BYTE incidenceAngleIndex(2)
    REAL*4 Tc(2,180)
END STRUCTURE

STRUCTURE /L1CSSMIS_S3/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(180)
    REAL*4 Longitude(180)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(180)
    REAL*4 incidenceAngle(1,180)
    BYTE sunGlintAngle(1,180)
    BYTE incidenceAngleIndex(4)
    REAL*4 Tc(4,180)
END STRUCTURE

STRUCTURE /L1CSSMIS_S2/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(90)
    REAL*4 Longitude(90)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(90)
    REAL*4 incidenceAngle(1,90)
    BYTE sunGlintAngle(1,90)
    BYTE incidenceAngleIndex(2)
    REAL*4 Tc(2,90)
```

```
END STRUCTURE

STRUCTURE /SCSTATUS/
    INTEGER*2 SCorientation
    REAL*4 SClatitude
    REAL*4 SClongitude
    REAL*4 SCaltitude
    REAL*8 FractionalGranuleNumber
END STRUCTURE

STRUCTURE /SCANTIME/
    INTEGER*2 Year
    BYTE Month
    BYTE DayOfMonth
    BYTE Hour
    BYTE Minute
    BYTE Second
    INTEGER*2 MilliSecond
    INTEGER*2 DayOfYear
    REAL*8 SecondOfDay
END STRUCTURE

STRUCTURE /L1CSSMIS_S1/
    RECORD /SCANTIME/ ScanTime
    REAL*4 Latitude(90)
    REAL*4 Longitude(90)
    RECORD /SCSTATUS/ SCstatus
    BYTE Quality(90)
    REAL*4 incidenceAngle(1,90)
    BYTE sunGlintAngle(1,90)
    BYTE incidenceAngleIndex(3)
    REAL*4 Tc(3,90)
END STRUCTURE

STRUCTURE /L1CSSMIS_SWATHS/
    RECORD /L1CSSMIS_S1/ S1
    RECORD /L1CSSMIS_S2/ S2
    RECORD /L1CSSMIS_S3/ S3
    RECORD /L1CSSMIS_S4/ S4
END STRUCTURE
```